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**Noninvasive Electrical Monitoring of Ion Current, Ion Energy, Electron Temperature, and Electron Yield** MARK SOBOLEWSKI, NIST — Traditional plasma diagnostic techniques that require inserting a probe into a plasma are not compatible with commercial plasma reactors and the manufacturing environment. In contrast, the radio-frequency (rf) current and voltage across a discharge can easily be measured outside the reactor, without perturbing the plasma or process. Furthermore, the waveforms of rf current and voltage contain information about process-relevant plasma properties. For example, one technique [1] has been developed which uses a numerical model of the plasma and its sheaths to analyze the waveforms and determine from them the total ion current and ion energy distributions. This method, however, assumes that the electron temperature is constant, and it neglects any emission of electrons from the electrode or substrate surfaces. To investigate errors arising from these assumptions, variations in electron temperature were measured by a Langmuir probe during fluorocarbon plasma etching of silicon dioxide films, and values for the yield of ion-induced and photon-induced electron emission were estimated. These results allow the resulting uncertainties in ion current and ion energy to be quantified. They also provide tests of how well the existing technique can be extended to also provide monitoring of electron temperature and emitted electron yield, in addition to ion current and ion energy. [1] M. A. Sobolewski, J. Vac. Sci. Technol. A 24, 1892 (2006).

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